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Description

PERIMETER-COOLED STAGE 1 BUCKET CORE STABILIZING DEVICE AND RELATED METHOD

BACKGROUND OF INVENTION

[0001] This invention relates generally to the casting of perimeter-cooled buckets for a gas turbine and, more specifically, to a stabilization device for an internal core used in the bucket casting process.

[0002] In an effort to improve the cooling scheme of a stage 1 gas turbine bucket, a "pants-leg" shaped core has been used in the bucket shank portion of the shell die to form a pair of cooling passages in place of a previous design utilized to form a plurality of radial cooling holes. In the casting process, however, the core tended to drift significantly, resulting in wall thicknesses in the shank portion of the bucket being out of tolerance.

[0003] Core stabilizing devices or "printouts" for improving the yield of a bucket casting process have been previously

used in stage 2 buckets, but with a different core design and in a different location relative to the so-called angel wings on the exterior of the shank portion of the bucket. Because of the different design of the stage 1 and stage 2 buckets, it was not possible to simply scale up the stage 2 bucket core for use in the stage 1 bucket casting process.

SUMMARY OF INVENTION

[0004] This invention provides stabilization devices on the core used for casting stage 1 gas turbine buckets. Because of the interior configuration of the shank portion of the bucket, and in light of the desire to have the stabilizing devices laterally aligned, it was necessary to move the stabilizing devices or printouts radially downwardly in the shell die so as to be located below the external angel wings of the cast bucket.

[0005] It is also a feature of the present invention that the cross sectional shape of the stabilization devices or printouts is of elliptical rather than the oblong or rounded rectangular shape used with the printouts for the casting of stage 2 buckets. By making the printouts elliptical in cross-sectional shape, the flat surfaces of the prior design have been eliminated, and stresses, particularly at the intersection of the printouts and the core, have been reduced.

[0006] Accordingly, in one aspect, the present invention relates to a core for use in casting a gas turbine bucket, the core comprising a solid upper body portion and a pair of legs extending downwardly from the solid upper body portion, the pair of legs separated by an elongated slot, and a pair of pegs projecting axially from opposite sides of the upper body portion, above the elongated slot but spaced from an upper edge of the upper body portion.

[0007] In another aspect, the invention relates to a core for use in casting a gas turbine bucket, the core comprising a solid upper body portion and a pair of legs extending downwardly from the solid upper body portion, the pair of legs separated by an elongated slot, and a pair of pegs projecting axially from opposite sides of the upper body portion, above the elongated slot but spaced from an upper edge of the upper body portion, and wherein the pegs are elliptical in cross section.

[0008] In still another aspect, the invention relates to a method of controlling wall thickness in the shank portion of a turbine bucket during casting comprising: a) providing a core comprising a solid upper body portion and a pair of legs extending downwardly from the solid upper body portion, the legs separated by an elongated slot; b) supporting the

core within a shell die by a pair of laterally aligned pegs extending from opposite ends of the solid upper body portion, the pegs located above the slot and below an upper edge of the upper body portion.

[0009] The invention will now be described in connection with the drawings identified below.

Brief Description of Drawings

[0010] FIGURE 1 is a partial cross section of a shank portion of a stage 1 bucket cast n accordance with the invention;

[0011] FIGURE 2 is a perspective view of a core used in casting the bucket shown in Figure 1;

[0012] FIGURE 3 is a front elevation of the core shown in Figure 2;

[0013] FIGURE 4 is a rear elevation of the core shown in Figure 1;

[0014] FIGURE 5 is a side elevation of the core shown in Figures 2-4.

Detailed Description

[0015] With reference to Figure 1, a stage 1 turbine bucket 10 includes an airfoil portion 12 and a shank portion or shank 14. The shank includes a plurality of so-called angel wings 16, 18 and 20 that serve as seals vis-a-vis adjacent buckets when installed on the rotor wheel of a gas tur-

bine. The interior of the shank portion includes a hollow space 22, with a central divider 24 that establishes side-by-side cooling passages 26 and 28. Elliptical holes 30 and 32 are cast in the fore and aft shank walls 34 and 36, respectively, as a byproduct of having the core supported in the shell die during casting.

[0016] Turning to Figures 2-5, the core 38 has a generally "pants-leg" shape with a solid upper body portion 40 and a pair of radially inwardly extending legs 42 and 44 in accordance with an exemplary embodiment of the invention. A pair of stabilizing pegs or printouts 46, 48 extend axially from opposite sides of the core while an elongated radially extending slot 54 separates the pants-leg portions 42 and 44. Notice that the core is curved in its solid upper portion so as to provide convex and concave surfaces (50, 52), respectively.

[0017] It will be appreciated that in the casting process, the reinforcing pegs or printouts 46, 48 will be supported within aligned holes in the shell die, thus forming holes 30, 32 in the fore and aft walls of the shank portion of the cast bucket. At the same time, the slot 50 will create the center partition 24.

[0018] By locating the stabilizing pegs or printouts 46, 48 radi-

ally below the angel wings 16, 18, sufficient room is provided so that the printouts 46, 48 may be directly across from one another, i.e., aligned both axially and radially. After the casting process is completed, and the core removed, holes 30, 32 remain in the bucket and must be plugged. By laterally aligning the holes 30, 32, plugs can be inserted and press fit simultaneously in the holes 30, 32 from opposite directions, without creating any asymmetrical stresses on the bucket.

[0019] It is also a feature of this invention, as best seen in Figure 5, that the stabilizing pegs or printouts 46, 48 have a cross sectional shape that is elliptical. The elliptical cross-sectional shape reduces stress at the intersection of the printouts and respective ends of the core by eliminating flat surfaces. When the casting process has been completed, the elliptical holes may be redrilled to a round shape and plugged with cylindrical plugs.

[0020] While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood that the invention is not to be limited to the disclosed embodiment, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the

spirit and scope of the appended claims.